

C3245 Log Data Report

Borehole Information:

Borehole: C3245		Site: 216-A-19 Trench			
Coordinates (WA State Plane)		GWL (ft)¹: 256.42	GWL Date: 4/18/2003		
North N/A ³	East N/A	Drill Date April 2003	TOC² Elevation N/A	Total Depth (ft) 256.82	Type Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded Steel	0.2	10 3/4	9 3/4	0.5	0	53.7
Threaded Steel	1.0	9	8	0.5	0	123.0
Threaded Steel	1.01	6 9/16	5 9/16	0.5	0	254.32
The driller provided the casing diameters and depths. The stick ups were measured.						

Borehole Notes:

Zero reference is the ground surface. This borehole was logged through the drill pipe in stages through single strings of casing. Approximately 6 in. of crushed gravel was present at the surface, and there appeared to be some fill inside the 8-in. casing. Depth to bottom and depth to water were provided by the geologist.

Logging Equipment Information:

Logging System: Gamma 2E	Type: 70% HPGe
Calibration Date: 03/2003	Calibration Reference: GJO-2003-430-TAC
Logging Procedure: MAC-HGLP 1.6.5, Rev. 0	

Logging System: Gamma 2F	Type: Moisture (H380932510)
Calibration Date: 10/2002	Calibration Reference: GJO-2002-387-TAC
Logging Procedure: MAC-HGLP 1.6.5, Rev. 0	

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2/Repeat	3	4/Repeat	
Date	4/7/03	4/7/03	4/10/03	4/10/03	
Logging Engineer	Pearson	Pearson	Pearson	Pearson	
Start Depth (ft)	53.5	11.0	121.0	73.0	
Finish Depth (ft)	0.0	6.0	50.0	66.0	
Count Time (sec)	100	100	100	100	
Live/Real	R	R	R	R	
Shield (Y/N)	N	N	n/a ⁴	n/a	

Log Run	1	2/Repeat	3	4/Repeat	
MSA Interval (ft)	0.5	0.5	1.0	1.0	
ft/min	n/a	n/a	n/a	n/a	
Pre-Verification	BE014CAB	BE014CAB	BE018CAB	BE018CAB	
Start File	BE014000	BE014108	BE018000	BE018072	
Finish File	BE014107	BE014118	BE018071	BE018079	
Post-Verification	BE014CAA	BE014CAA	BE018CAA	BE018CAA	
Depth Return Error (in.)	1.0 low	1.0 low	n/a	.25 low	
Comments	Adjusted fine-gain after files: BE014052 BE014099	No fine-gain adjustments.	No fine-gain adjustments.	No fine-gain adjustments.	

Log Run	5	6/Repeat			
Date	4/18/03	4/18/03			
Logging Engineer	Pearson	Pearson			
Start Depth (ft)	256.0	160.0			
Finish Depth (ft)	118.0	145.0			
Count Time (sec)	100	100			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	1.0	1.0			
ft/min	n/a	n/a			
Pre-Verification	BE026CAB	BE026CAB			
Start File	BE026000	BE026139			
Finish File	BE026138	BE026154			
Post-Verification	BE026CAA	BE026CAA			
Depth Return Error (in.)	n/a	.25 low			
Comments	No fine-gain adjustments.	No fine-gain adjustments.			

Neutron-Moisture Logging System (NMLS) Log Run Information:

Log Run	1	2/Repeat	3	4/Repeat
Date	4/7/03	4/7/03	4/10/03	4/10/03
Logging Engineer	Pearson	Pearson	Pearson	Pearson
Start Depth (ft)	0.0	4.0	50.0	64.0
Finish Depth (ft)	53.75	9.0	121.0	71.0
Count Time (sec)	n/a	n/a	n/a	n/a
Live/Real	n/a	n/a	n/a	n/a
Shield (Y/N)	N	N	N	N
MSA Interval (ft)	n/a	n/a	n/a	n/a
ft/min	1.0	1.0	1.0	1.0
Pre-Verification	BF039CAB	BF039CAB	BF044CAB	BF044CAB
Start File	BF039000	BF039215	BF044000	BF044285
Finish File	BF039214	BF039234	BF044284	BF044313
Post-Verification	BF039CAA	BF039CAA	BF044CAA	BF044CAA
Depth Return Error (in.)	n/a	0.0	n/a	2.0 high
Comments	No fine-gain adjustments.	None	No fine-gain adjustments.	None

Log Run	5	6/Repeat		
Date	4/18/03	4/18/03		
Logging Engineer	Pearson	Pearson		
Start Depth (ft)	118.0	215.0		
Finish Depth (ft)	256.0	230.0		
Count Time (sec)	n/a	n/a		
Live/Real	n/a	n/a		
Shield (Y/N)	N	N		
MSA Interval (ft)	0.25	0.25		
ft/min	1.0	1.0		
Pre-Verification	BF048CAB	BF048CAB		
Start File	BF048000	BF048553		
Finish File	BF048552	BF048613		
Post-Verification	BF048CAA	BF048CAA		
Depth Return Error (in.)	n/a	2.0 high		
Comments	No fine-gain adjustments.			

Logging Operation Notes:

Zero reference was the ground surface, and the borehole was logged through drill pipe. Logging was performed with a centralizer installed on the sonde.

SGLS data were collected using Gamma 2E. Pre- and post-survey verification measurements employed the Amersham KUT (^{40}K , ^{238}U , and ^{232}Th) verifier with serial number 082.

Analysis Notes:

Analyst:	Sobczyk	Date:	4/28/03	Reference:	GJO-HGLP 1.6.3, Rev. 0
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SGLS pre-run and post-run verification spectra were collected at the beginning and end of the day and compared to the control limits. The verification spectra were all within the control limits. The peak counts per second (cps) at the 609-keV, 1461-keV, and 2615-keV photopeaks on the post-run verification spectra as compared to the pre-run verification spectra for each day were between 1.0 percent higher and 3.0 percent lower at the end of the day.

NMLS pre-run and post-run verification spectra were collected at the beginning and end of the day and compared to the control limits established on 12/05/2002. Spectra BF044CAB and BF048CAA were within the control limits. The other verification spectra were slightly above the upper control limit of 735 cps. Post-run verification spectra BF048CAA and BF039CAA registered 741 cps versus 737 cps in the pre-run verification spectrum BF039CAB and post-run verification spectrum BF044CAA.

SGLS log spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Verification spectra were used to determine the energy and resolution calibration for processing the data using APTEC SUPERVISOR. Concentrations were calculated in EXCEL (source file: G2EMar03.xls), using parameters determined from analysis of recent calibration data. Zero reference was the ground surface. On the basis of measurements supplied by the driller, the casing configuration was assumed to be one string of 10-in. casing to 53.7 ft, one string of 8-in. casing to 123 ft, and one string of 6-in. casing to 254.32 ft. Below 254.32 ft, open hole was logged to a depth of 256 ft. The casing correction factor was calculated using a casing thickness of 0.5 in. for the 10-in., 8-in., and 6-in. casings. Because the borehole was logged in stages, the casing correction is not additive; the borehole was logged through one string of casing during each logging run. However, the ends of logging

runs 3 and 5 were run in a dual string of pipe and the casing correction is additive (0.5 in. + 0.5 in. = 1.0 in.). Dead time and water corrections were not needed or applied to the data.

NMLS log spectra were processed in batch mode using APTEC SUPERVISOR to determine count rates. Zero reference was the ground surface. Calibration data are not available for the 10-in. casing, and the volume fraction of water was not calculated.

Log Plot Notes:

Separate log plots are provided for gross gamma and dead time, gross gamma and neutron total counts, naturally occurring radionuclides (^{40}K , ^{238}U , and ^{232}Th), and man-made radionuclides. Plots of the repeat logs versus the original logs are included. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable level (MDL) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, or casing correction. These errors are discussed in the calibration report. A combination plot is also included to facilitate correlation. The ^{214}Bi peak at 1764 keV was used to determine the naturally occurring ^{238}U concentrations on the combination plot rather than the ^{214}Bi peak at 609 keV because it is less affected by the presence of radon in the borehole.

Results and Interpretations:

^{137}Cs , ^{238}U , and ^{235}U were the man-made radionuclides detected in this borehole. ^{137}Cs was detected near the ground surface (1 ft through 11 ft) at concentrations ranging from 0.4 to 40 pCi/g. ^{137}Cs was also detected at 23 ft, 193 ft, and 194 ft with a concentration near its MDL of approximately 0.2 pCi/g. Processed ^{238}U was detected in the interval from 6.5 ft through 30.5 ft at concentrations ranging from 18 pCi/g to 560 pCi/g. The maximum concentrations for both ^{137}Cs and ^{238}U were measured at 8 ft. During the repeat log run, ^{235}U was detected at 8 ft with a concentration of approximately 8 pCi/g.

Between 35 ft and near the ground surface, ^{238}U (609 keV) concentrations are approximately 1/2 pCi/g higher than those based on the 1764-keV photopeak. This behavior suggests that radon may be present inside the borehole casing. The effects of radon on borehole logging are described in GJO-HGLP 1.6.3, Rev. 0 (2003).

The presence of radon is not an indication of man-made contamination; it is derived from decay of naturally occurring uranium. As a gas, radon moves easily in the subsurface, and concentrations of radon and its associated progeny can change quickly.

Recognizable changes in the KUT logs occurred in this borehole. At 12 ft, there is a 4-pCi/g decrease in ^{40}K concentration and a 0.4-pCi/g decrease in ^{232}Th concentration. This decrease in apparent ^{40}K and ^{232}Th concentrations probably corresponds with the base of the trench. At 190 ft, there is a 4-pCi/g decrease in ^{40}K concentration.

The plots of the repeat logs demonstrate reasonable repeatability of the SGLS and NMLS data. The man-made and natural radionuclides at energy levels of 662, 1001, 609, 1461, 1764, and 2614 keV are comparable between the repeat and original SGLS log runs. The total neutron counts per second and its repeat log are within the acceptance criteria.

¹ GWL – groundwater level

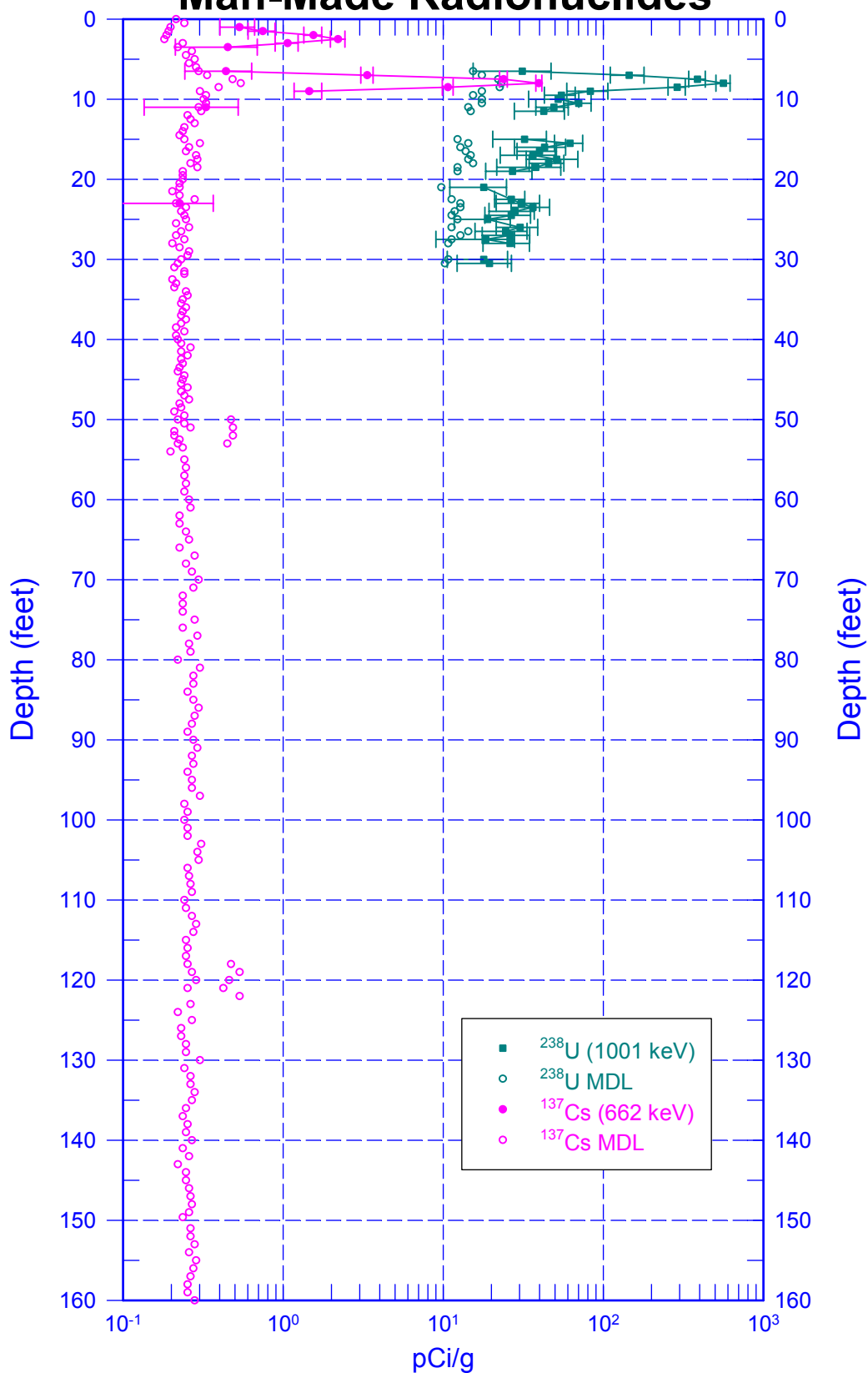
² TOC – top of casing

³ N/A – not available

⁴ n/a – not applicable

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Man-Made Radionuclides

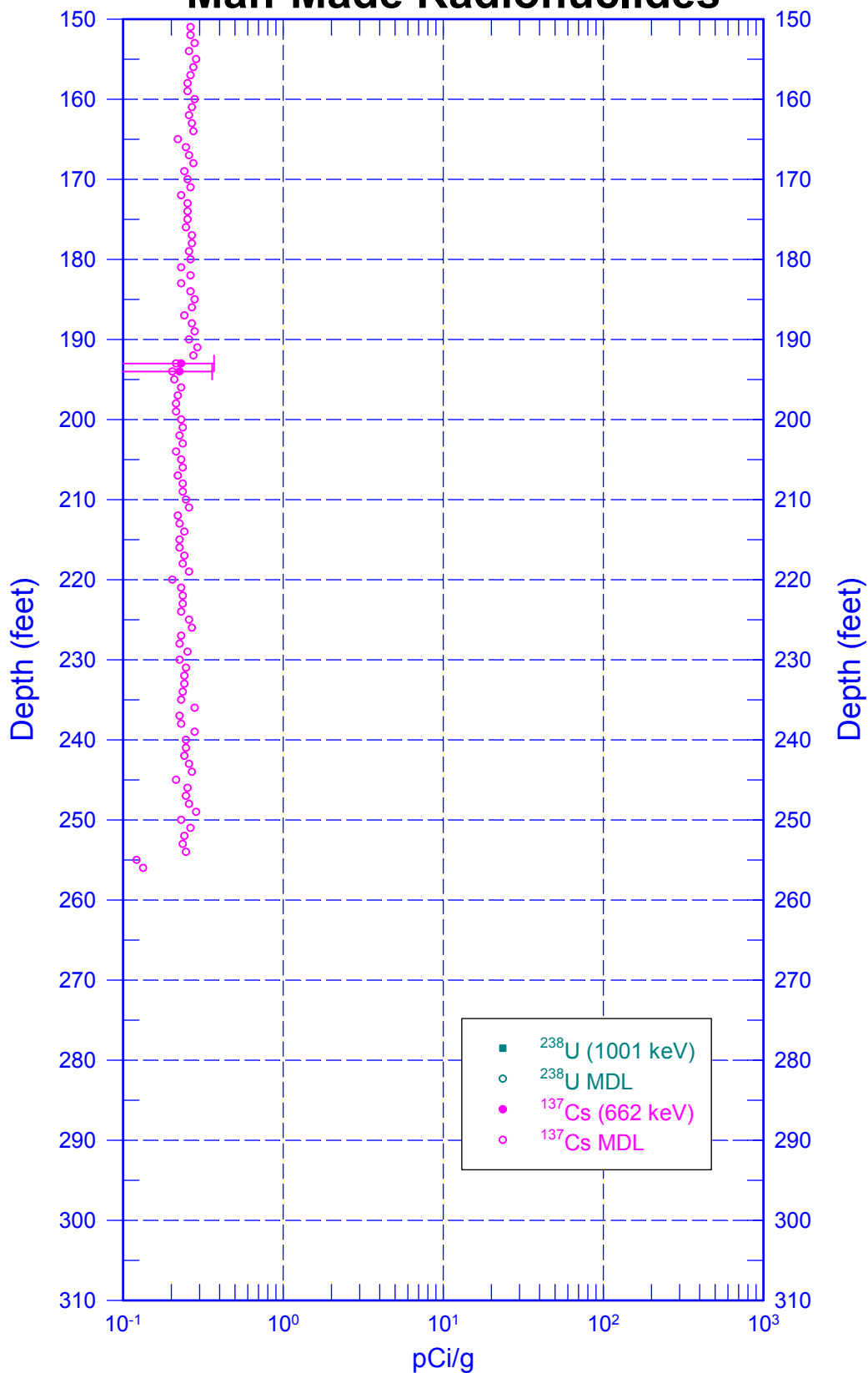


Zero Reference = Ground Surface

Date of Last Logging Run
4/18/2003

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Man-Made Radionuclides

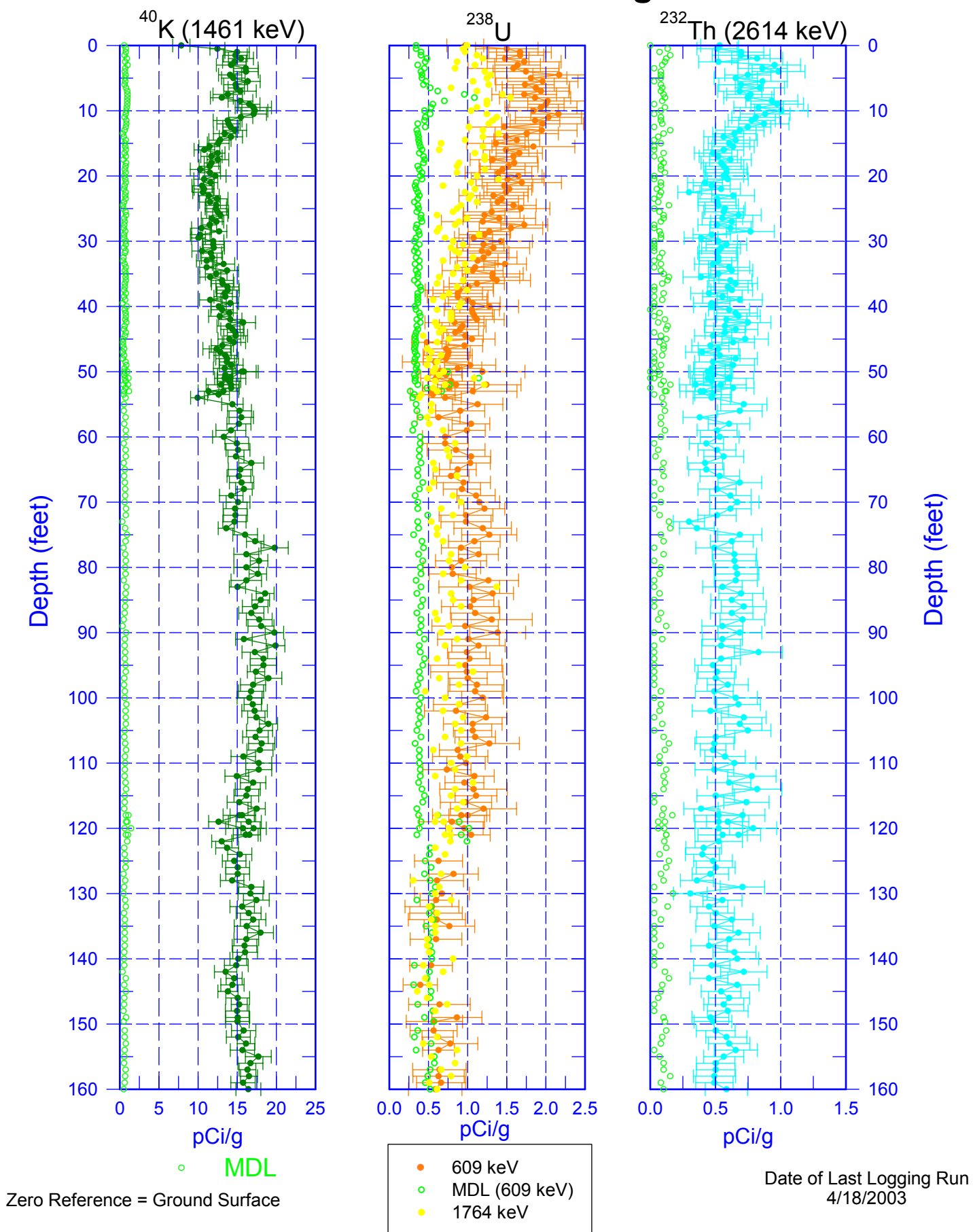


Zero Reference = Ground Surface

Date of Last Logging Run
4/18/2003

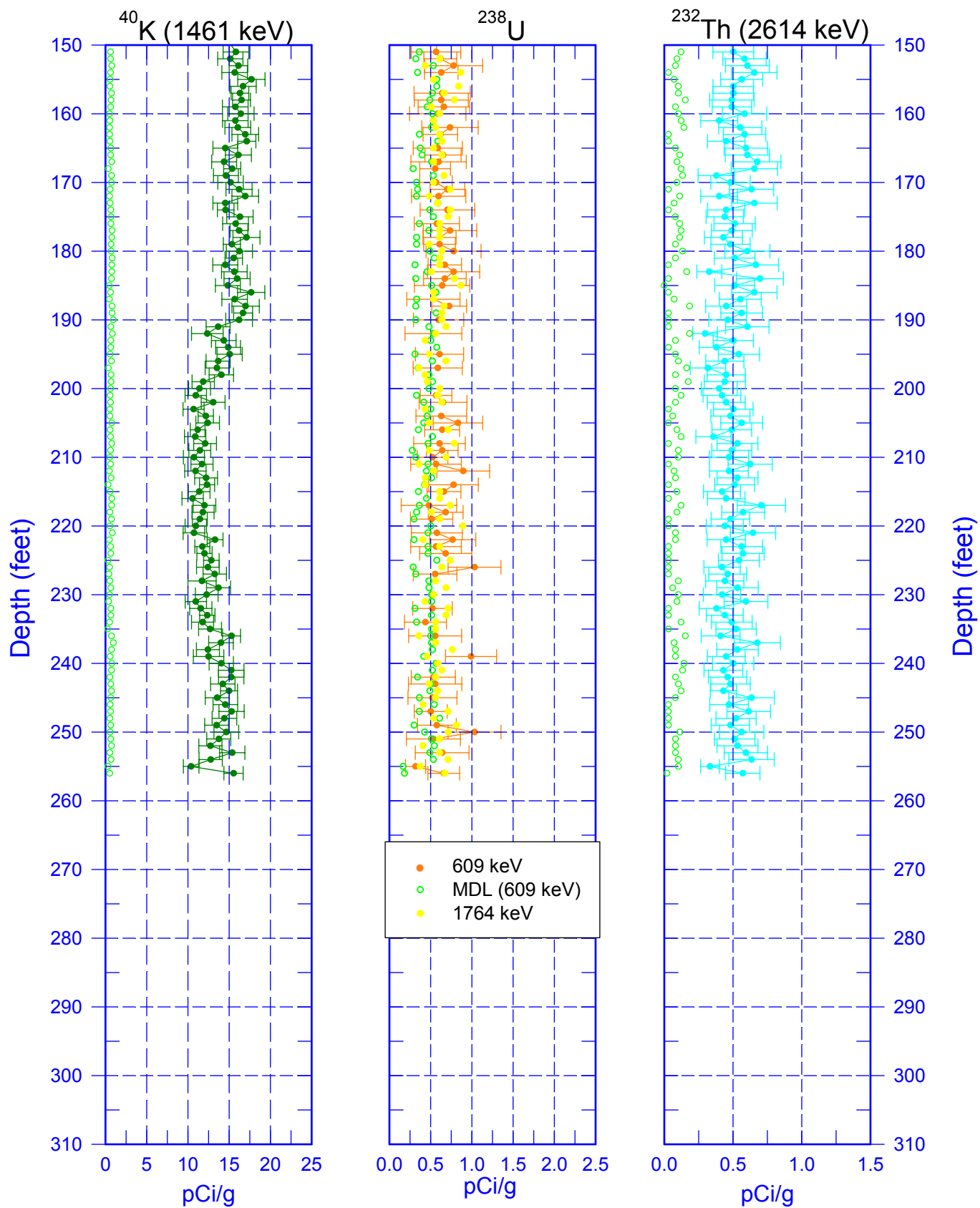
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Natural Gamma Logs



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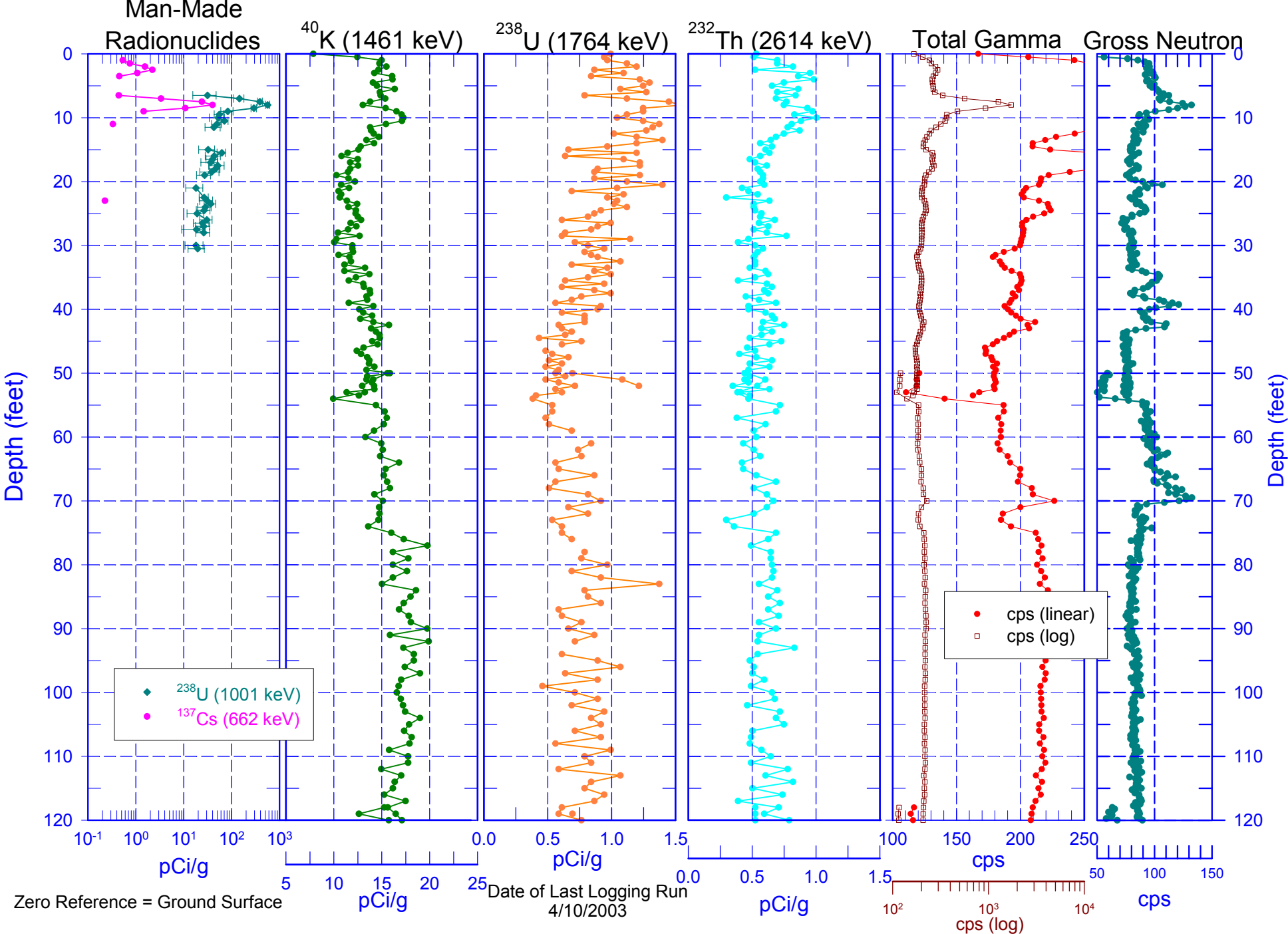
Natural Gamma Logs



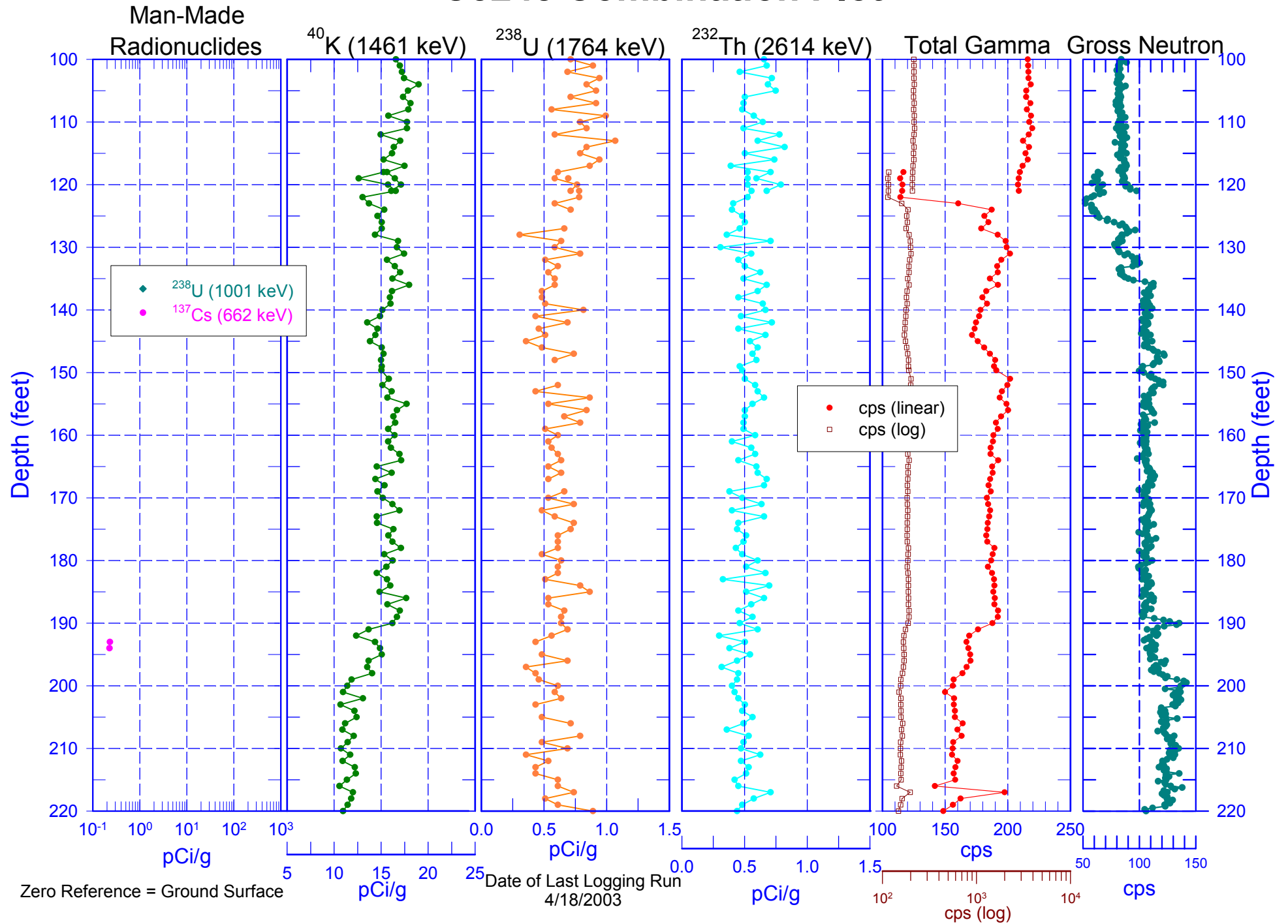
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Date of Last Logging Run
4/18/2003

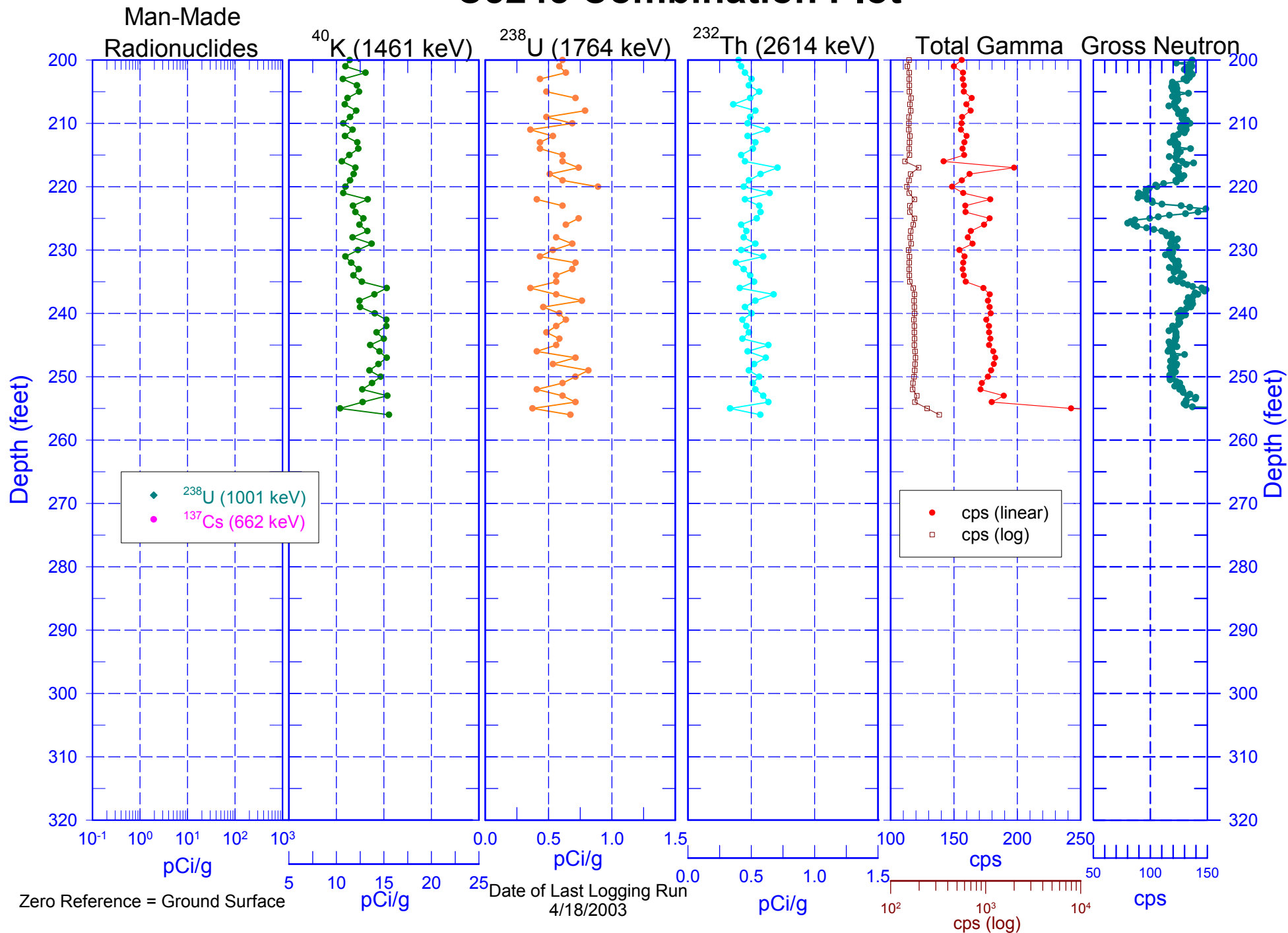
C3245 Combination Plot



C3245 Combination Plot

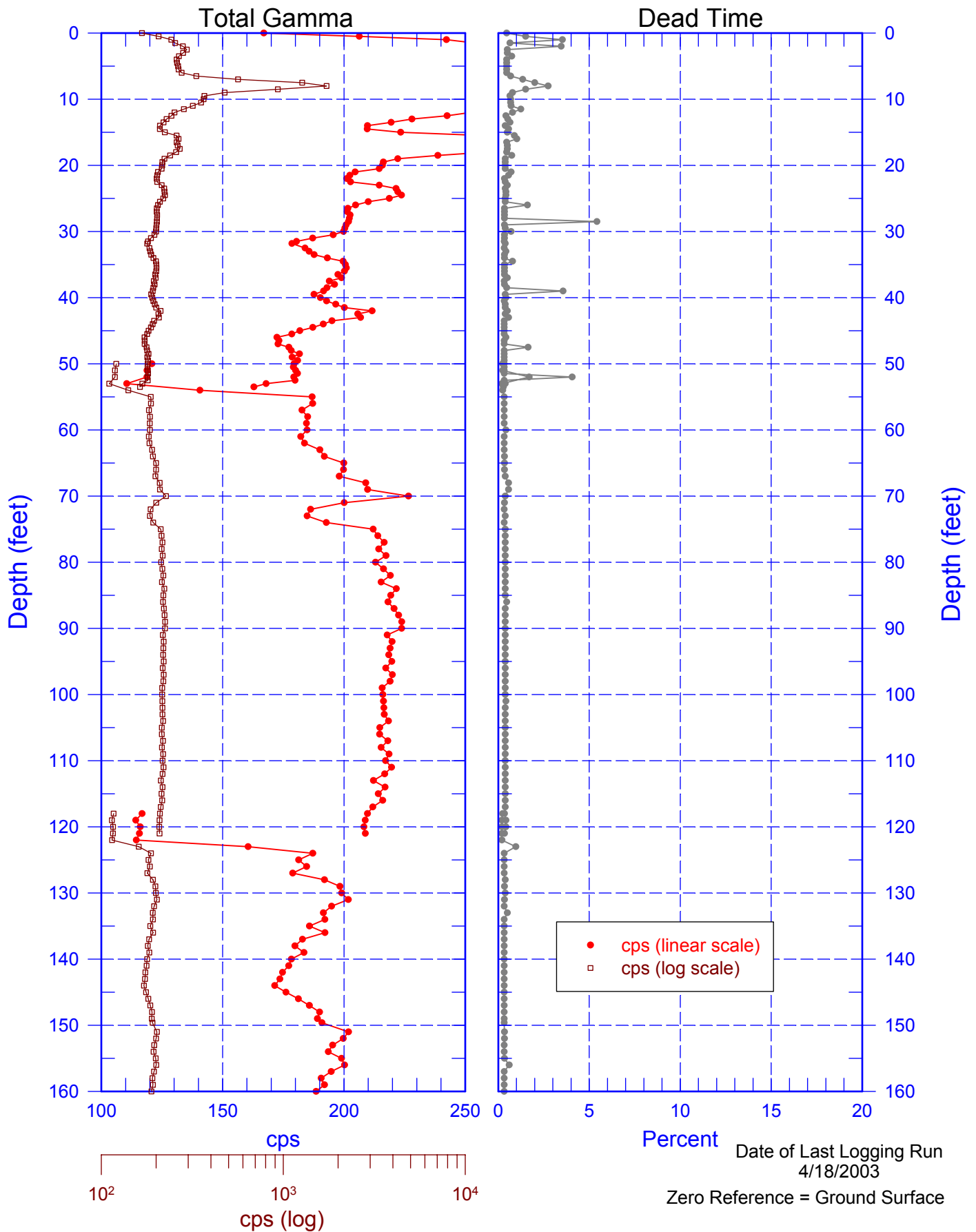


C3245 Combination Plot



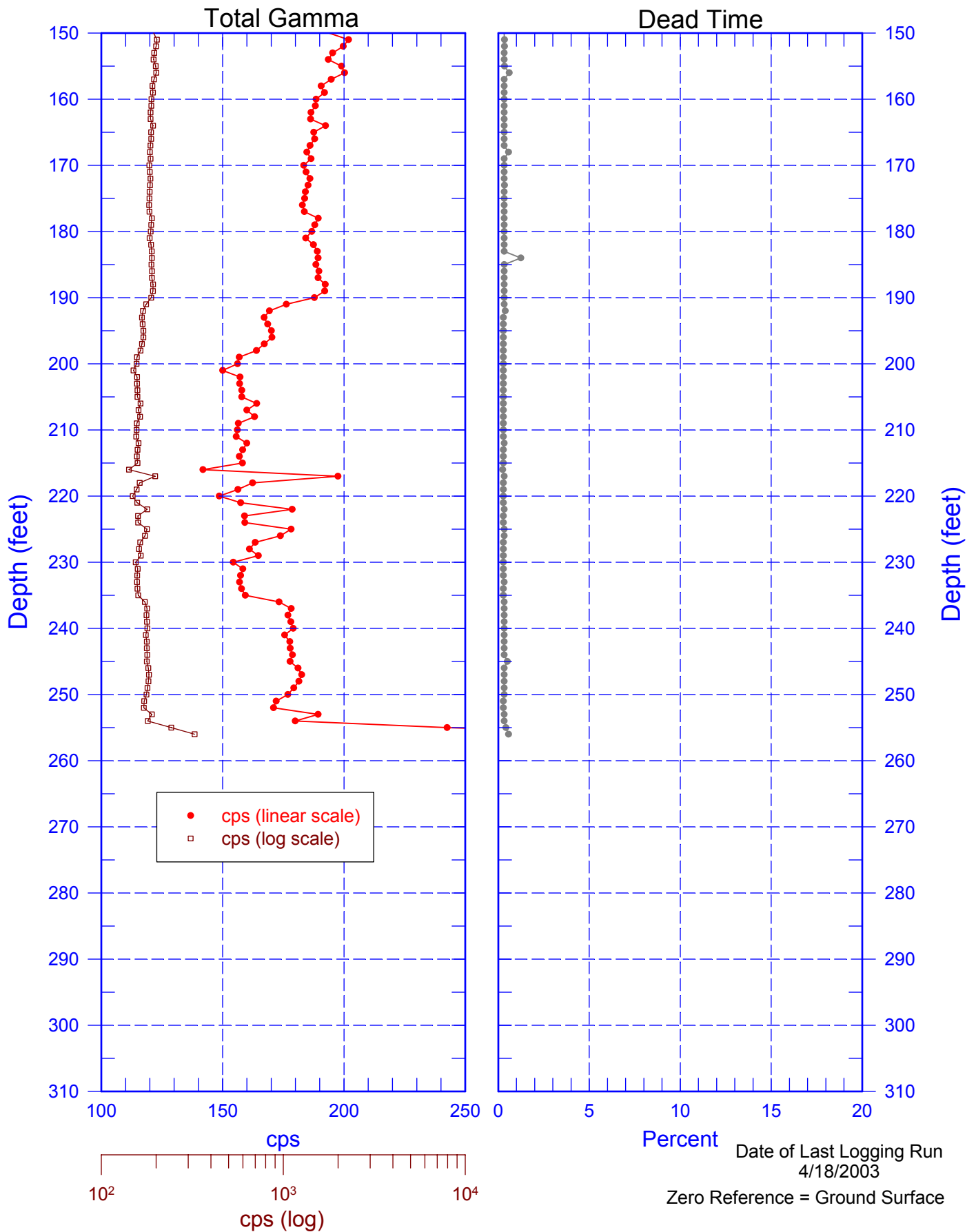
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Total Gamma & Dead Time



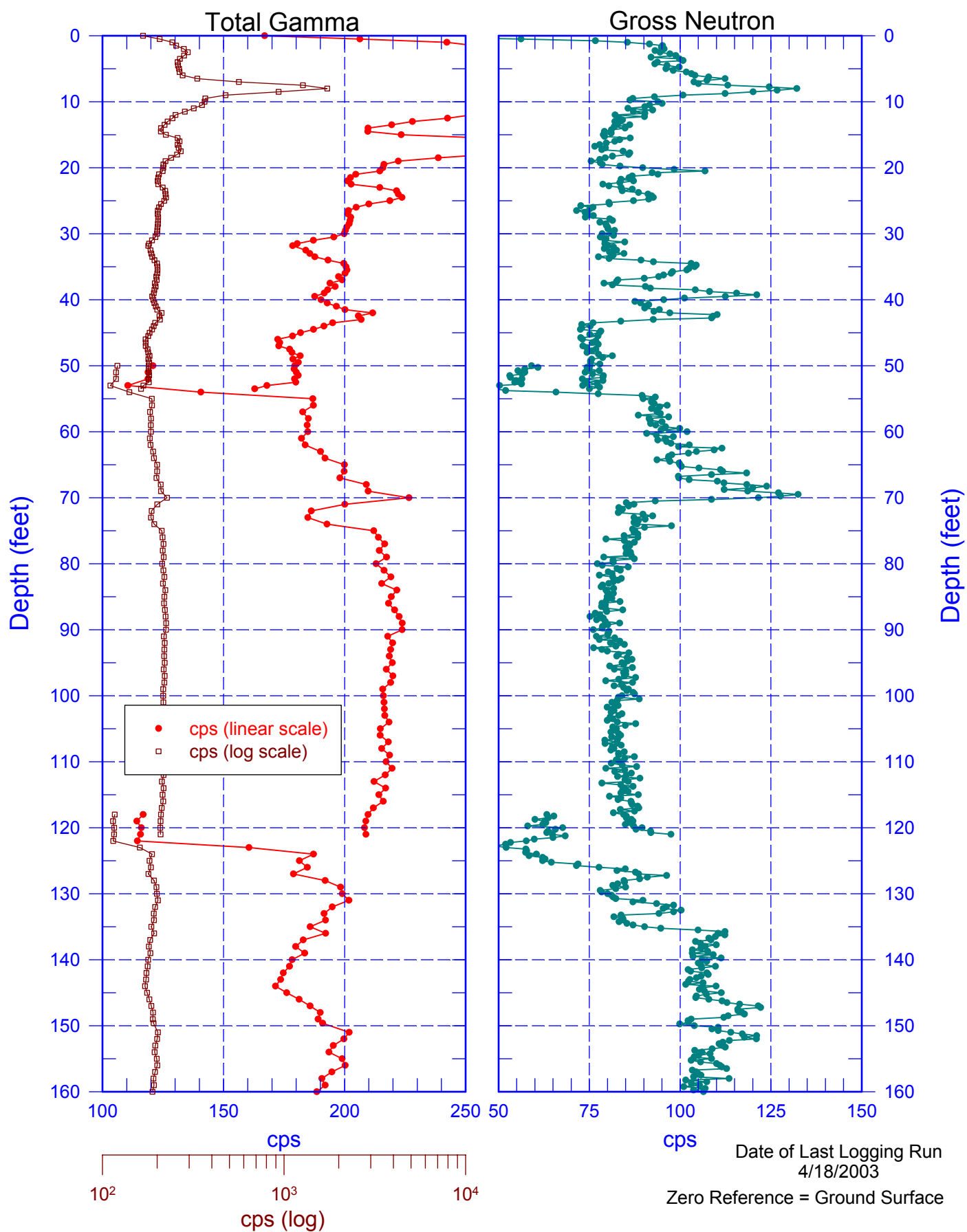
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Total Gamma & Dead Time



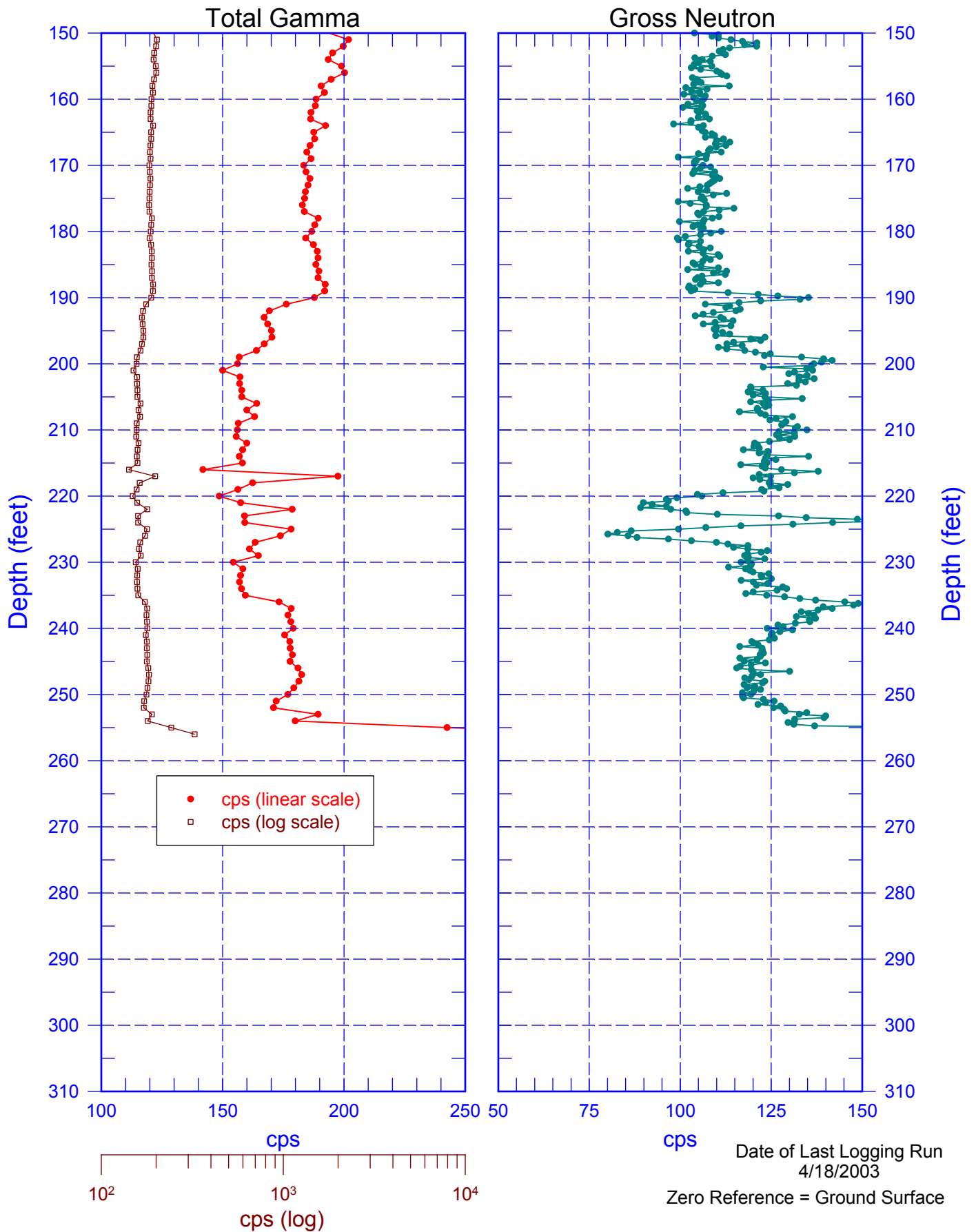
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Total Gamma & Neutron



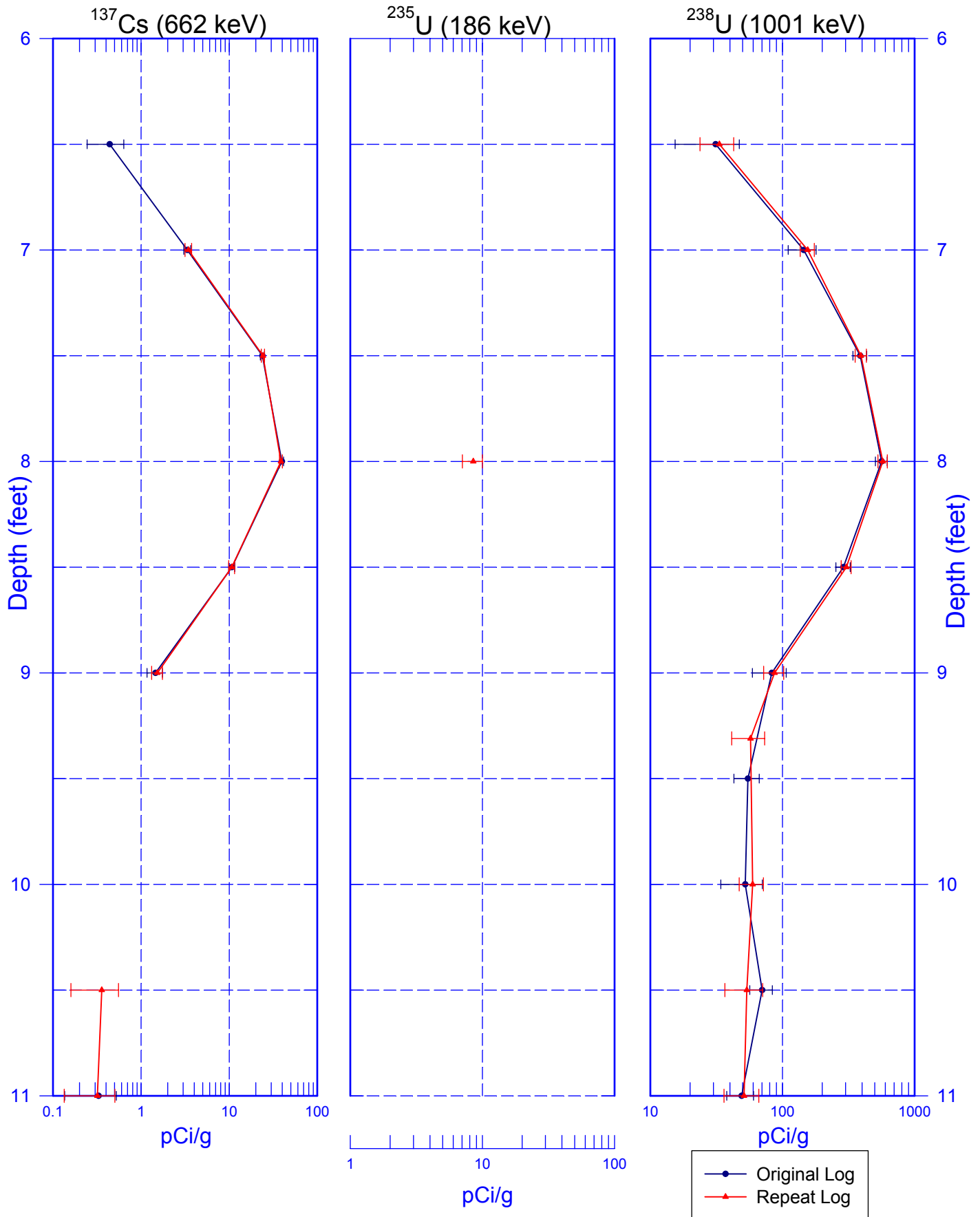
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Total Gamma & Neutron



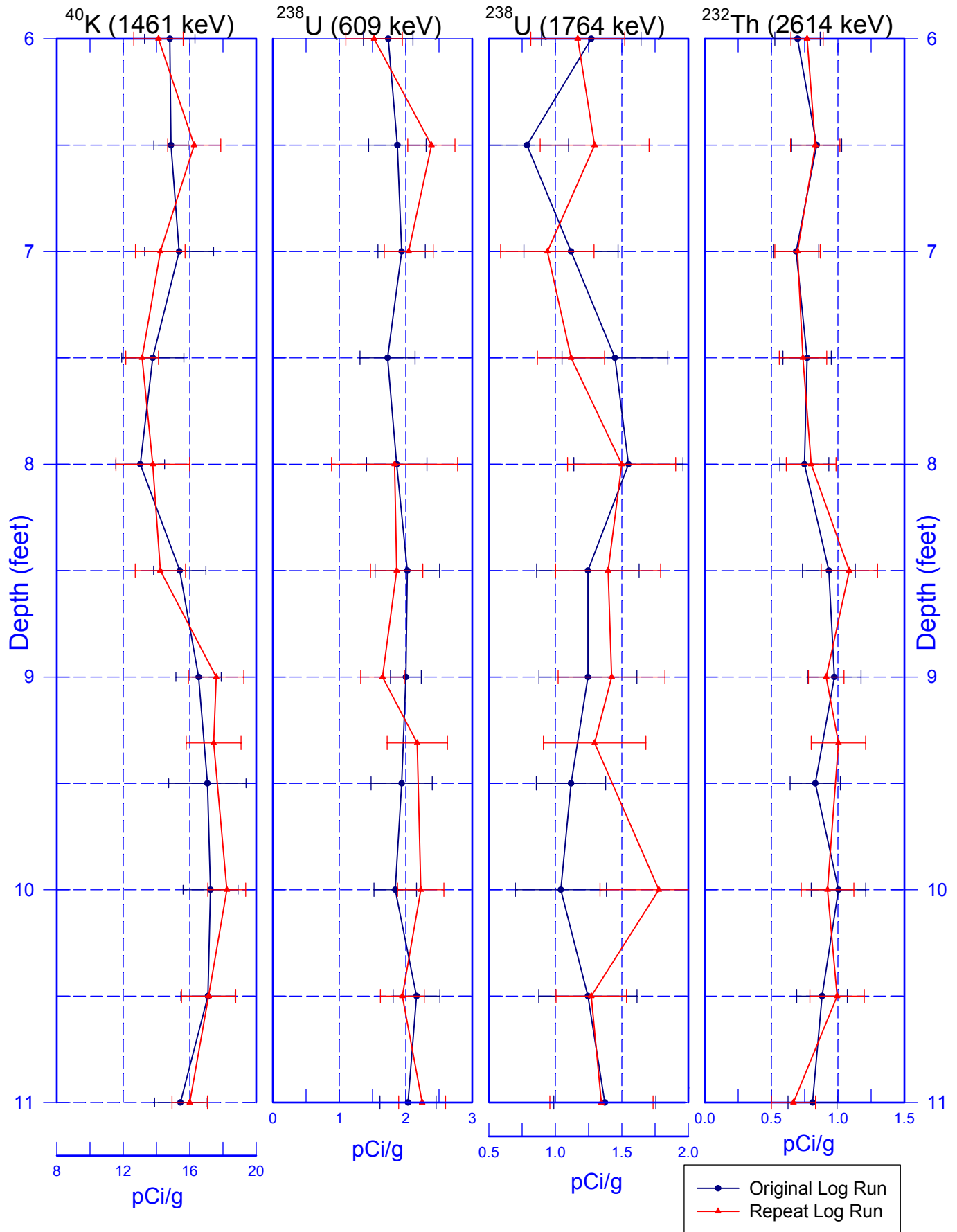
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Rerun of Man-Made Radionuclides (11.0 to 6.0 ft)



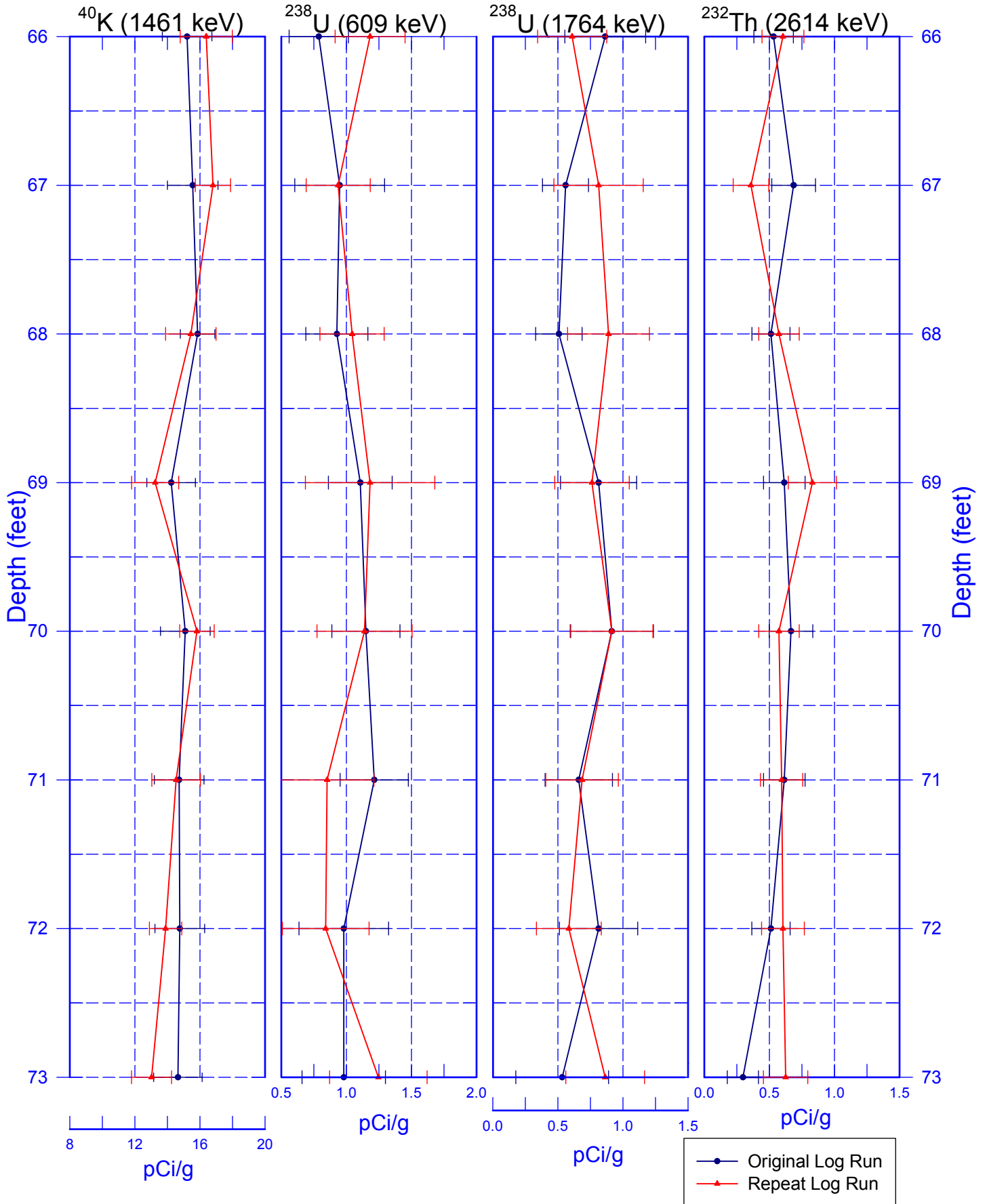
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Rerun of Natural Gamma Logs (11.0 to 6.0 ft)



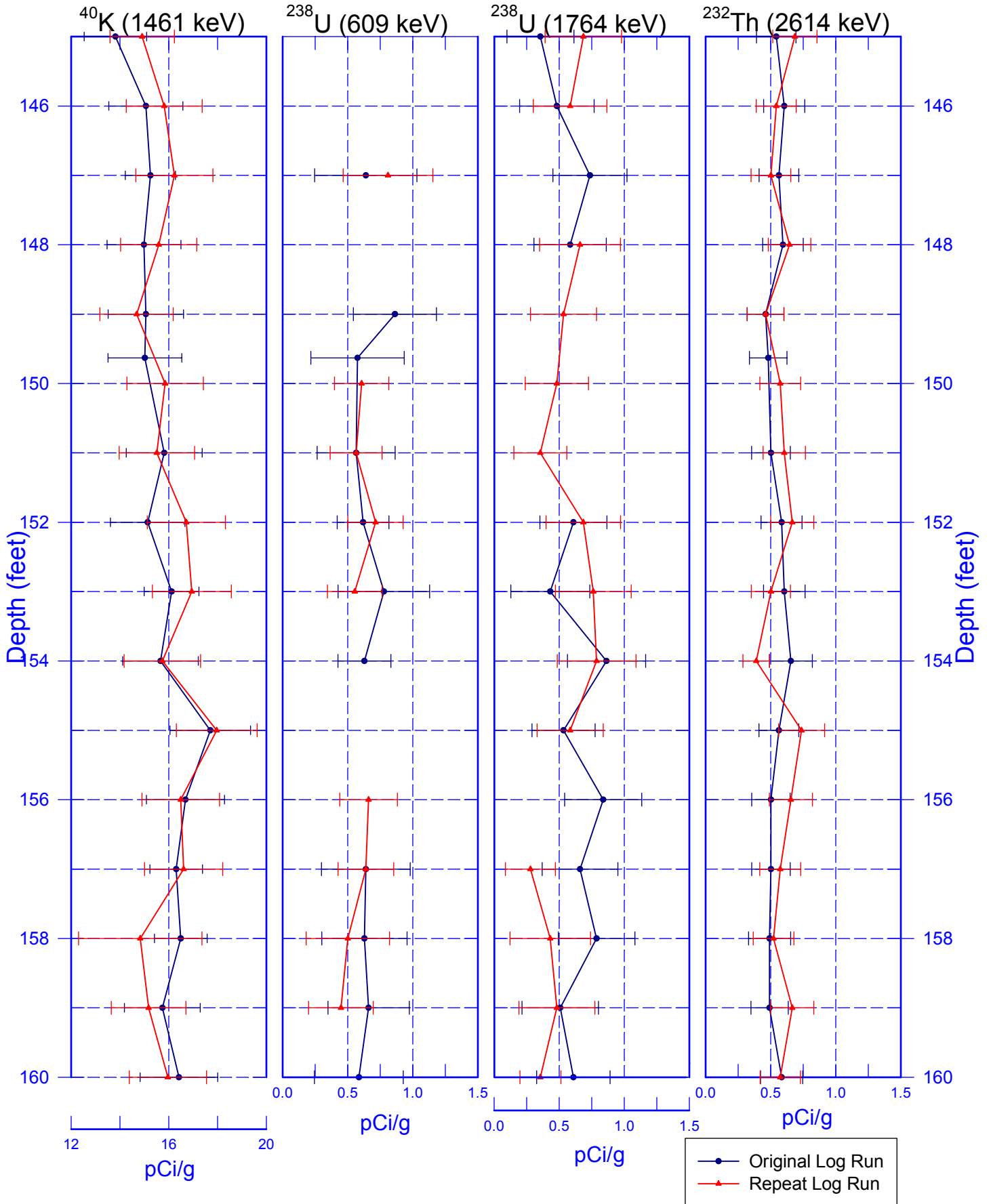
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Rerun of Natural Gamma Logs (73.0 to 66.0 ft)



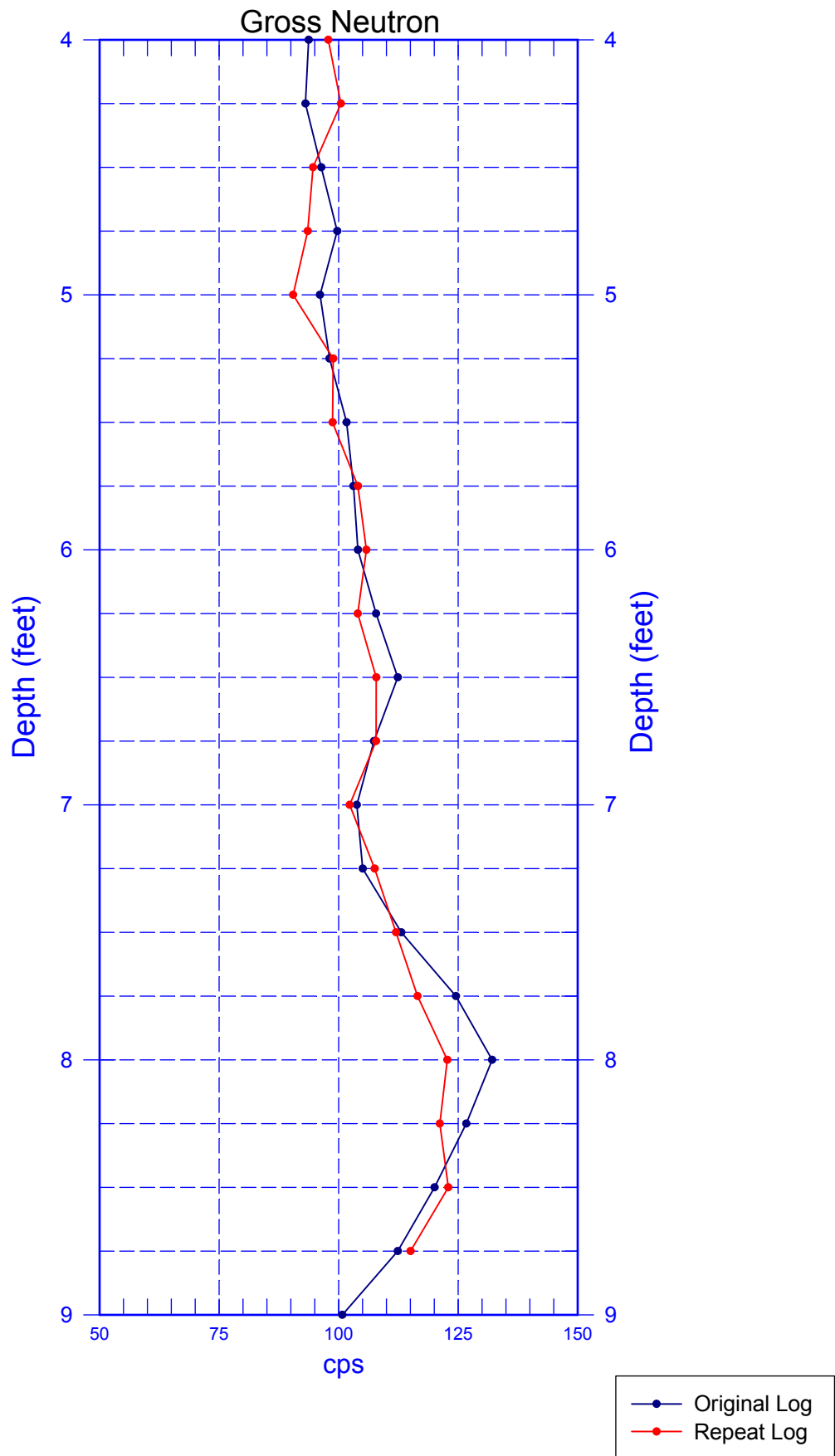
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Rerun of Natural Gamma Logs (160.0 to 145.0 ft)



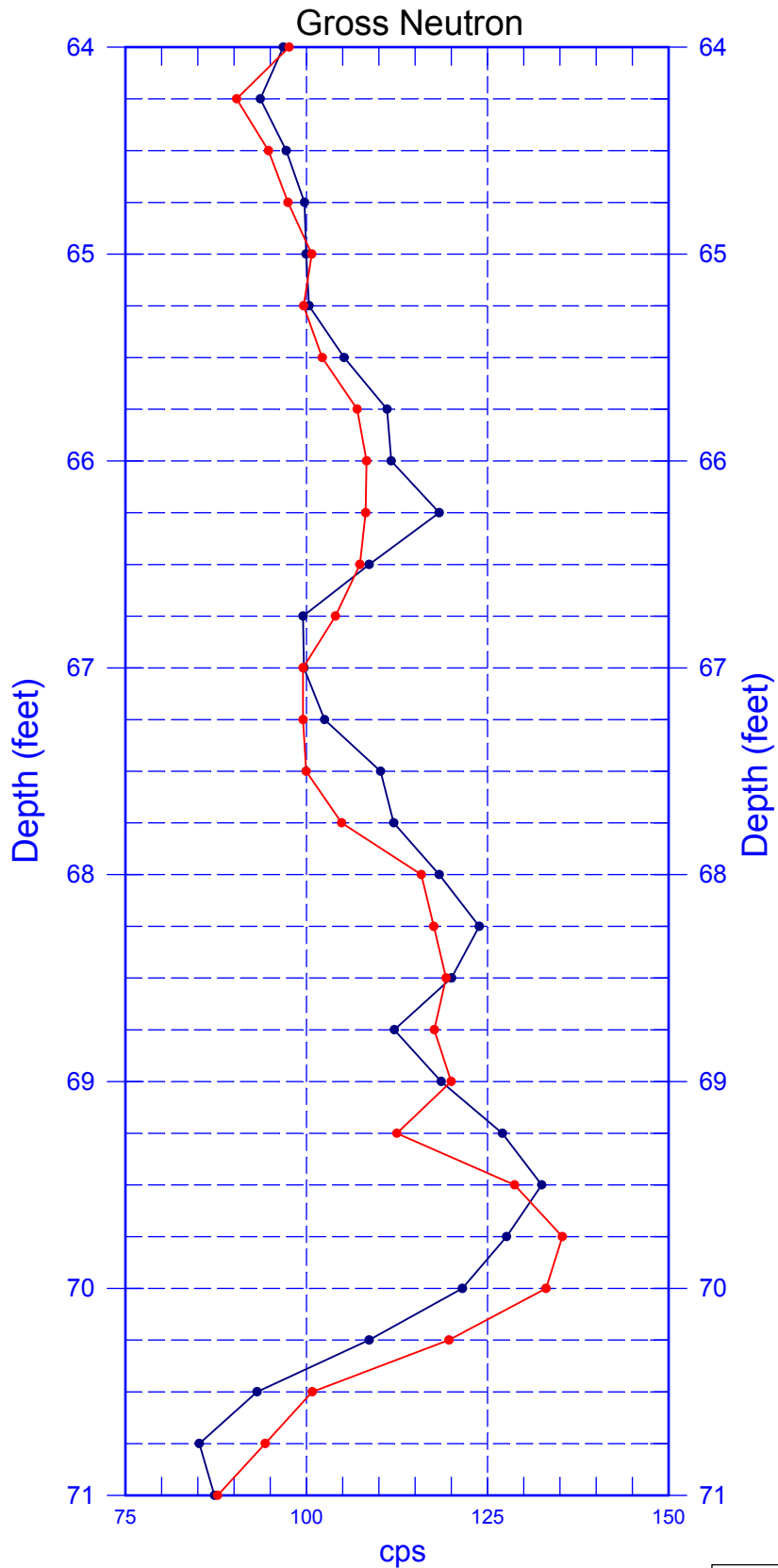
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Rerun of Neutron-Moisture Log (4.0 to 9.0 ft)



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Rerun of Neutron-Moisture Log (64.0 to 71.0 ft)



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Rerun of Neutron-Moisture Log (215.0 to 230.0 ft)

